AUTODESK UNIVERSITY 2013

The Asset Paradigm: Maximizing the Value of BIM for Facilities Management and O&M

Andrew Hill – CSI Global Services

FM2226

As Building Information Modeling (BIM) has matured, we have gained the ability to link and integrate data from the BIM model to many other systems. This class focuses on integrating BIM with facilities management (FM) and operations and maintenance (O&M). The class describes how we include the FM team during design to enable full integration of systems, as well as integrating facility data to enable access to information from many standard FM products. We review an example of how we applied data to the BIM model and delivered it to the FM products, enabling a familiar interface for FM and O&M managers to manage the facility after construction. We also look at using virtual FM, which enables a facility to be tested during design and construction. This is a must-attend class for building owners and facility managers who want to maximize the benefits of BIM from design to asset management.

Learning Objectives

At the end of this class, you will be able to:

- **Communicate your BIM vision to consultants and contractors**
- **Determine which information is important and structure a workflow that allows information flow**
- **Work with multiple parties to understand requirements for FM and O&M systems**
- **Integrate BIM data into facility data systems**

About the Speaker

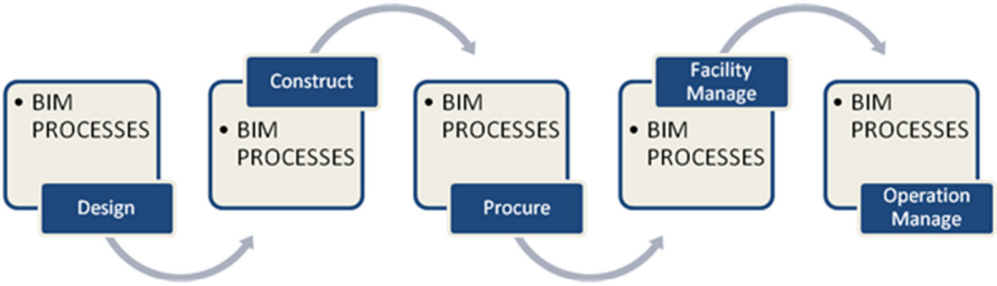
Andrew is the Chief Operating Officer, Board Member and one of the founding shareholders of CSi Global Services. In this capacity he is responsible for all of the deliverables of a highly skilled team in relation to the implementation and adoption of BIM for construction and infrastructure projects globally. Andrew has been working with CADD & design technology for over 20 years starting out in the mechanical area before studying civil, structural and mechanical engineering. Andrew has lectured both at university and technical college in engineering and run the design teams for a large consulting engineering company in the mechanical, civil and structural disciplines. Andrew now works with some of the leading companies globally as well as owners and governments in a thought leadership capacity and has been recognised for this expertise in delivering process change management solutions to an international clientele.

andrew.hill@csigs.com.au

Communicating the BIM Vision

When communicating to parties on BIM refrain from “BIM 101”; many times within BIM 101 BIM is referred to as a technology or singular model delivery methodology for design. BIM is far more complex than this and when defining the BIM vision for a project the type of BIM needs to first be ascertained. BIM can fall into many categories including:

- Design BIM
- Construction BIM
- Procurement
- Facility Management
- Operations and Maintenance



The outcomes from all of these are very different which is why it is important to define the where, what and why of BIM to each of these levels and build your success and vision from this. The critical understanding here is to realize that you do not specify BIM for the sake of BIM, BIM is a project delivery methodology that is employed to achieve a particular outcome for a project.

The first critical task is therefore to effectively communicate the vision for what you really want to achieve for the project. A mission statement is the intrinsic, ‘Why?’ and indicates BIM’s purpose within the business; the vision becomes the “How?” and is the compass from which everything else is driven. The Alliance for Nonprofit Management, a professional association of non-profit business managers, defines a vision statement as, “…If a strategic plan is the ‘blueprint’ for an organization’s work, then the vision is the ‘artist’s rendering’ of the achievement of that plan. It is a description in words that conjures up a similar picture for each member of the group of the destination of the group’s work together. “ This concept highlights the value of BIM’s contributions within the organization now and in the future. Every assignment, every objective stems from this vision and defines the basic goals for everyone within the business to achieve that vision.

Establishing a carefully planned and documented vision with input from every aspect of BIM to be achieved creates a personal ownership for every individual within the team and clearly then articulates the business goals.

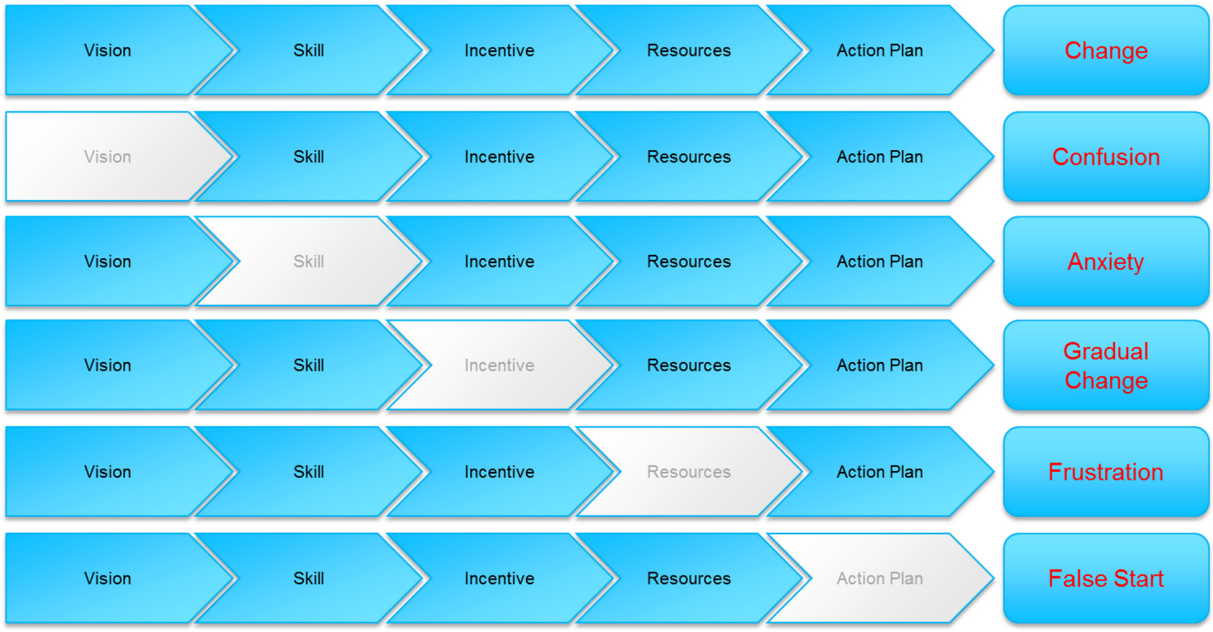
Once BIM is clearly understood by the business this understanding can then be passed to any consultants working on projects with clarity and assurance that there are key rationalizations and assurances to the benefits of this particular BIM delivery.

A clear vision is not the only component to ensure BIM is successful throughout the business. Vision will avoid confusion but to drive change other aspects will need to be considered including:

- Vision
- Skill
- Incentive
- Resources
- Action Plan

BIM is a methodology for project delivery that incorporates processes far beyond the development of construction documents and can impact on every aspect of the delivery of a project both within the office and on the job site. As such implementing BIM within a business and/or project requires careful change management.

The chart below is a typical example of the factors that should be considered as a part of change management and will need to be considered in the implementation of BIM.



As can be determined from the above chart there can be major implications to successful BIM without all of the elements being addressed sufficiently prior to implementing BIM.

Vision

Several notes on vision have been made already, the following covers the specifics of how vision affects and impacts on change management.

Vision will be the definition of the corporate goals and strategies for BIM and deliverables over the next twelve months, three years and 5 years. This will be critical to building and defining the cross functional requirements of BIM within any business and setting goals and milestones for achieving the corporate vision. This corporate vision will be commissioned with input from all key stakeholders in the business which may include executive sponsors, design groups, information technology, GIS, asset management, innovation etc. this team can be commissioned to address the vision and goals for BIM in a corporate sense prior to any other activity as all other activities will be dependent on this corporate plan.

Without this vision there will be confusion on the BIM strategy and many groups will just define their own goals which will not address the interoperable nature of businesses today.

Skill

Skills refers to the definition and mapping of skill requirements that will be required for the successful implementation of BIM within the business. Skills here is a combination of;

- Technology application usage skills
- Workflow process skills
- Understanding and knowledge of the end product;
    - In terms of BIM
    - In terms of the final end product (actual building, etc)
- Understanding of the needs of downstream and upstream BIM users

As can be identified from the above list, skill does not just refer to user training in technology but looks at both technical competency and knowledge from a role, process and task point of view to achieve the business goals for BIM and the project. It is sometimes seen as beneficial to address skills based on a singular technology that has a designated output function to the business but in the collaborative BIM environment there will be a need to structure a full skills matrix to address all of the required functions for a particular role as they relate to BIM within the business. This matrix may redefine some functions and responsibilities in the skill base to ensure that all interoperable dependencies required for BIM are structured to support the entire business and as a result the skills matrix should be cable of measuring the “as-is” versus “as-required” state..

Without the proper skills designation and applicable matrix of skills there will be anxiety that the business cannot fulfil its requirements for BIM.

Below is an example of a skills matrix based on a particular role:

Model Author Skills Matrix

	Model Generation						Configuration					BIM Processes					
	Model Setout	Model Development	Data Editing	Documentation Output	Model Output	External Model Coordination	Content Editing	Content Creation	Template Configuration	Data Field Creation	Calculation Development	Design Analysis Process	Constructability Process	Spatial Coordination Process	Time Sequencing Process	Visualisation Process	Quantities and Cost Process
Required Proficiency	4	5	5	5	4	4	3	3	1	3	3	4	4	5	4	4	4
Staff Member 1																	
Staff Member 2																	
Staff Member 3																	

Expert	5
Proficient	4
Training Complete	3
Requires Training	2
No Skill	1

Incentive

No process change occurs without the backing and support of people, be that in a group (business, department, team) or individual. There are 2 basic methods of getting people onboard with a change, carrot or stick. The stick is already covered by contracts, incentives form the carrot.

The incentives for BIM need not be financial in nature but can take many forms such as a certification process, preferred consultancy agreements for conformance to plans etc. that would facilitate the adoption and progression of BIM within the business and extended project teams. Internally this may even cover items such as BIM certification, similar in format to an ISO 9001 certification that covers and promotes BIM users and BIM workflows. With larger and more complicated organizations it is important to ensure there is some way of incentivizing the business to change, grow, and adopt these processes and structures.

Without these incentives the change and progression to BIM will occur but it will be stymied and slower than could be possible with a proper program.

Resources

Resources and resource availability within any business and consultants working on projects is not just a matter of having critical mass but also having the resources that fit into the skill structure as identified earlier. Ensuring appropriate resources may require some new positions being trained as well as staff in existing roles being cross-trained in the BIM methodologies and technologies to enable sufficient traction for the BIM processes. This allows a certainty that one resource is not going to be fully accountable for the delivery of any activity as this will lead to staff discontent which in turn can lead to project failure. Technology can only equate to a small productivity gain with the majority through the BIM processes which will only be realized through proper resource planning and structure.

Without the appropriate resources this will fragment in the BIM process and become frustrated that there is a vision to achieve BIM but no resources or inadequate resources to deliver on the vision. This is not uncommon within many businesses and although some companies feel there could be pressure to replace staff this is always accurate as it is in most cases easier to train an established person in new processes and technologies rather than train a good technologist the processes and culture of an organization.

Action Plan

The action plan will ensure that all aspects of the BIM implementation are covered and all milestones are outlined. This is really a BIM project management plan that facilitates the long term implementation strategies of BIM within the business. This plan will be aligned to all other strategies and ensure that all goals are achievable and reportable to ensure that the BIM implementation is progressing and accurate. The action plan will cover all tasks from preliminary vision and goal setting, through all documentation and change management requirements and then to full BIM utilization. The action plan will also include all reporting, meetings, issues and successes of the implementation.

Many companies with best BIM intentions who have not implemented a BIM project management plan have found that although there is some short term success based on the passion to change this is not sufficient to continue the change and can lead to a false start of failed implementation.

Once this plan is laid out communicating the vision of BIM becomes very easy as there is a clarity to the vision and commitment to deliver on this vision.

Determine which information is important and structure a workflow that allows information flow

The number one priority in ascertaining and structuring information and modeling requirements is inclusivity of all parties. Too often the BIM requirements are driven by the design consultants or within design and construct projects by the constructor making no consideration for the long term viability and usability of the model. To this end when considering the asset driven BIM model all parties need to be included whom drive the requirements for managing and maintaining assets.

Chances are most contractors on a project have had an experience similar to the following at some point during the last three years. A long-time owner-client tells them, "BIM is a requirement on this job." The contractor responds, truthfully, "That's great. We now have a few BIM projects under our belt and we're getting better. We're seeing real efficiency and productivity gains." Then, wanting to add value, they pose a few questions to the owner. "Do you mean BIM for design? BIM for construction? BIM for transition to facilities? All or some of those?" The owner responds, "Yes, all of those - especially BIM for FM." This prompts the contractor to ask the million dollar question, "Have your facilities maintenance, operations, and asset management teams reviewed the systems and processes they have in place, decided where they want to go, and clearly articulated those needs into specific deliverable requirements for BIM turnover at closeout?" At worst, the contractor is met with silence. At best, they hear a well-meaning response calling on a combination of broad concepts, tools, and emerging industry standards, " ... COBie ... IFC ... AIA© E202 ... ConsensusDOCS© 301 ... BIM Execution Plan ..." but one that is light on details.

This is then why defining the true goals and objectives is critical to successful BIM to FM. The only way this can be achieved is through a consultative approach with all parties are involved via a "work back schedule". This requires input from all parties as to "what are we trying to achieve" or the end goal of the BIM deliverables. If this is asset management then then particulars will need to be defined i.e. FM system, required data structure, preventative maintenance procedures.. etc. from hear a cross functional workflow will be defined looking at the requirements for each phase.

	Planning	**Design**	**Construction**	**Operations**
Architect				
Struc Engineer				
MEP Engineer				
Procurement				
Constructor				
Facility Manager				

Start with a simple spreadsheet and fill in all the requirements backwards ensuring all the operations information is included and then the implications for each previous phase. As an example operations will need to ensure that equipment is maintainable in the future therefore for a chiller the equipment would need to have clearance applied to facilitate maintenance and replacement. It would also have a part number or

asset number this would need to be included from selection. The earlier information can be included the easier the flow of the BIM model will progress and the earlier you can start running and testing the BIM model in facilities management, however this still needs to take into account who is the best person with the pre-requisite knowledge to deliver that information.

Successful BIM to FM transitions require an owner to be extremely specific in articulating their asset management goals and objectives – before uttering even one specific BIM technology, VDC technique, or nascent industry standard/protocol. Therefore, long before providing detail requirements for BIM deliverables, or timelines related to hand-over protocols, an owner must be able to explain to their project teams what is important to them in the long run.

The following are six questions that should be addressed in the beginning of any asset BIM process:

- From a cross-departmental stand-point, do the real estate, facilities, and accounting departments have a cohesive vision of asset-related desired levels of service and key performance indicators?
- Are there policies in place for cost-effective, prioritized, and data supported spending recommendations?
- How are current asset inventory records maintained within sensible thresholds?
- What is the procedure for modeling asset deterioration curves and determining associated renewal and repair costs?
- Are financial modeling tools in place for forecasting renewal and repair cost schedules and running budget scenarios?
- Depending on the size and scale of the project, will evaluation reports be produced for five, 10 and 30-year time horizons under current policies and procedures?

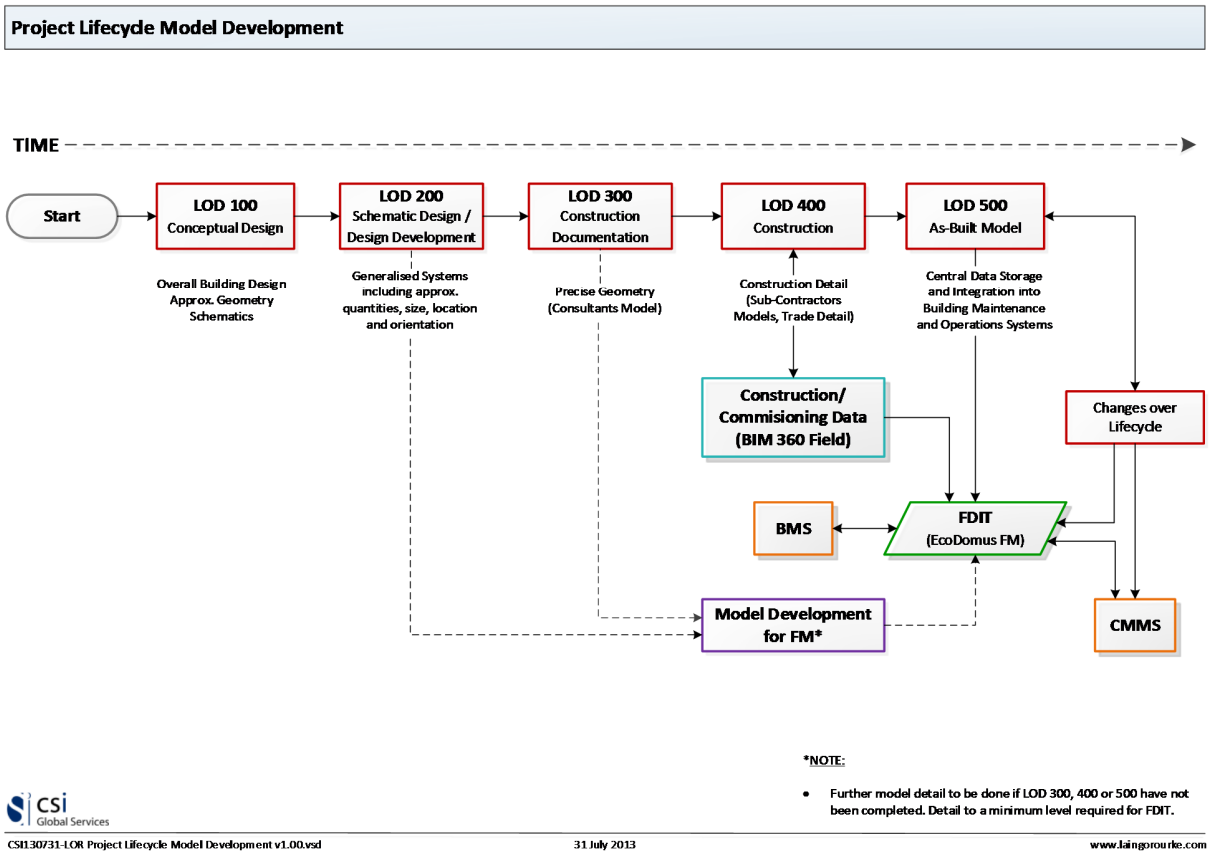
In the mission to realize cost savings from BIM to FM transitions, answering these questions is crucial.

As well as understanding the owner's asset management goals and objectives an in-depth understanding of the existing systems is also required. All owners, regardless of size, market sector, or building type, have some system or tools already in place to manage their facility maintenance, operations, and assets. Some use highly customized software platforms, others use simple spreadsheets. Understanding those systems and tools at a detailed level is critical to a meaningful BIM–FM transition. Owners cannot mandate and gather BIM project data without understanding when, where and how their existing internal systems will process the information that a project collects.

Accordingly, there is any number of questions from a project level that would still need to be addressed to a business whom has mandated asset BIM. For example, does the owner require a specific project management and/or document management system? Will that system be the single source of truth for all project information, or run in some form of parallel with the designer's and contractor's independent systems? Does the owner-mandated system remain in play (and to what degree) once the project is complete and transitioned to operations?

Then as a project nears completion there becomes other factors to be considered, has the commissioning agent been engaged in terms of BIM? Do their workflows and field tools acknowledge data links back to BIM data or geometry? Does the owner have a separate system for maintaining as-built information at project close? Is there overlap between the owner's project management software and the as-built documentation platform?

Once into operations and maintenance, does the owner utilize a computerized maintenance management system (CMMS)? Is there a BMS requirement? What platforms and tolls need to be integrated with? What are the inputs of critical importance to the CMMS and/or BMS? Do emerging industry protocols suit all of the owner's end-user needs? Similarly, does the owner's finance and accounting department see any benefit from project BIM data to support depreciation systems and analyses?

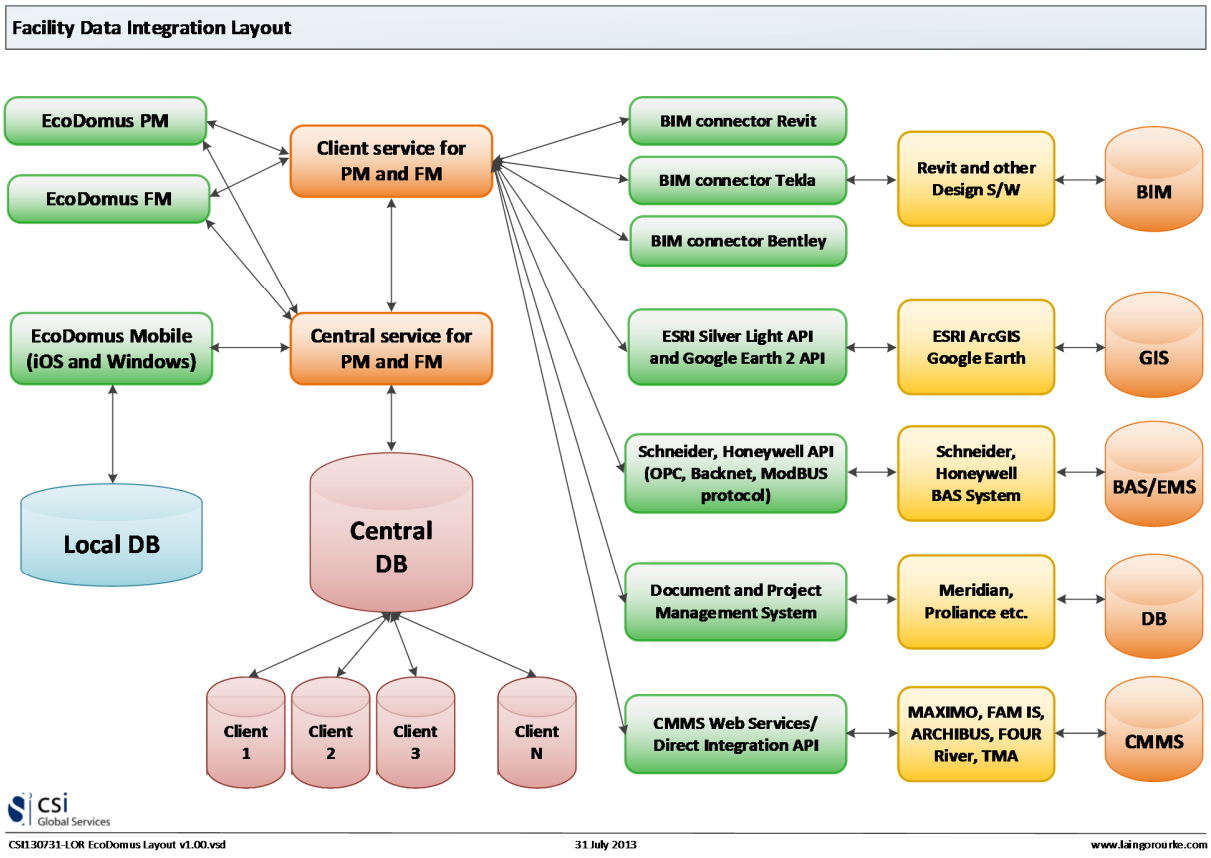


Once the needs of the final output and results are understood there can be the development of the model development requirements. This will require ensuring the LOD specification for each level is properly detailed in the BIM plan and then looking at how and when the FM integration will occur. The earlier model information can be tested in the asset environment the easier it will be to make subtle changes to the requirements and the cost of change will be reduced. This will allow for true model progression and the ability to have the assets evolve as the building does through design cycles.

Technology plans can be developed once all other integrations and workflows are completed as technology is only the enabler for BIM processes not the driver. This needs to look at all aspects that will integrate with the BIM process and the below is a guide to all the products utilized in a BIM to FM delivery for a Government project. There were other technologies utilized but this was the minimum specified in the scope of works.

Below is an example of a basic technology map;

Authoring Tool:	Revit Design Suite	Facility Data Integration:	EcoDomus
Collaboration Tool:	Navisworks	CMMS:	FSI
Add on:	iConstruct	BAS:	Schneider
Data Editing ++:	BIM Link	Site:	360 Field
Cost tool:	Costx		



Data integrations can now be built for each aspect of the project as a high level layout. This will enable the dissemination flow of information to each aspect of project delivery. In this example EcoDomus was the facility data integration tool but there are other tools that can be assessed throughout the industry to fulfill the various technology roles within the project BIM delivery.

Once all the workflows are progressed and the work back schedule completed then the requirements for each discipline can be assembled. The following sections are examples of discipline specific requirements that have been rolled out on projects to ensure BIM processes can occur. The majority of these examples are related specifically to BIM for FM, others are simply related to construction or other BIM functions.

Architectural Model Best Practice – Revit Architecture

The following data and general modelling should be applied to all Architectural models to allow for a streamlined model progression workflow from Consultant to Contractor and for the final O&M and FM of the facility.

Modelled Components

Ceilings

- **Extent** – Each ceiling plane should be modelled as a separate element
- **Bulk-heads** - The vertical section of the bulk-head is to be modelled as a Basic Wall Family Type. The vertical section of the bulk-head should only need to be modelled from 50% design development onwards
- **Insulation** – Any ceiling that includes insulation should have the insulation modelled. This will allow effective spatial coordination with the above ceiling services.

Columns

- **Architectural Columns** – Should only be used for non-load bearing columns. This may include brick piers or cladding to structural load bearing columns.

Floors

- **Floor Finishes** – should to be modelled separately from structural floor components for integration with the structural model

Rooms and Spaces

- **Plan Views -** Rooms are to be placed in plan views which are associated to the desired Level Datum.
- **Room Separation Lines -** The use of Room Separation Lines to substitute Walls should be avoided where possible.
- **Area Plans -** Consider using Area Plans if Rooms are not reporting the calculated values as per the area briefing specification.
- **Warnings** - Promptly resolve warnings about volume boundaries overlapping.
- Levels - If you have two levels within the same elevation, Revit will perform better if all volumes are placed on one of the two levels, rather than dividing the same volumes between the two levels.

Structure

- **Structural Members** - if required to be in the Architectural model they are to be created using the specified Structural toolset within Revit. This includes: Floors, Footings, Beams, Structural Columns, Bracing, Purlins and any other associated structure where required. Situations where these items are duplicated are noted in the BIM Implementation Plan.

Walls

- **Wall Openings** - Wall Opening Tool should be used to create any rectangular service penetration within the wall.
- **Wall Structure** – The function layer within the wall structure must be defined appropriately to allow wall layer zones to join correctly. Allocate as follows:
    - **Structure –** In situ concrete and precast concrete
    - **Substrate –** block or brickwork
    - **Thermal air layer –** Cavities, Insulation, Stud/furring, structural steel zones.
    - **Finish 1 –** Plaster board, F.C. and renders
    - **Finish 2** - Tiles
    - Note: The structure section of the wall should be specified within the wall core layers
- **Stacked Walls** - Avoid the use of Stacked Walls.
- **External Walls** - These should be made up of two separate wall types, as External and Internal as scope and extent are likely to be different. Ensure there is no more than 100mm gap between the walls and where openings are placed the walls should be joined (i.e. “Join Geometry”) to populate the opening to both.
- **Concrete Walls** - From 50% Design Development onwards, structural concrete (precast or in-situ) walls are to be modelled separate to the other wall layer build-up.
- **Precast Tilt-panel Walls** - These are to be modelled per-panel using the wall category and “split with gap” toolset, or broken and dimensionally constrained to controlling reference planes
- **Wall Tiles** - Where wall tiles are required to a small localised area, the split face tool and material assignment can be used.

Services Modelling Best Practice – Revit MEP

The following data should be incorporated into the MEP models to allow for a streamlined model progression workflow from Consultant to Sub-Contractor and for the final O&M and FM of the facility.

Duct and Pipe System Naming and Associated Identification

Model progression requires systematic isolation of all duct and pipe systems. Naming of these systems is critical to allow for quick transition from Design to construction. Naming conventions should address the following criteria

- Equipment Identification (Where the Duct or Pipe Systems originated from)
- Space / Room or Zone served. Can be derived from the Revit MEP Analysis tools.
- Type of System – Supply, Return Air, etc.
- Services Type – Cable Tray Identification. Should incorporate Switch Board and Switch Room Location.

Although the system types and associated System Classifications are and can be pre-defined, these alone are not sufficient to identify the exact system details.

Closed Systems and associated Data

It is important to ensure all duct and pipe systems are closed to allow for system information flow to exist within the models. This will allow for the Sub-contractors to assess equipment selections based on real data within the models as opposed to utilising antiquated calculation processes and take-off.

This requirement is based on data flow, and does not imply any particular requirement for the implementation of the calculation tools within Revit MEP.

Equipment Metadata

As part of any traditional Building services design, performance data is always provided to the Sub-Contractor as a basis for final Equipment selection. Building Services Consultant's utilise preferred catalogue data to select an appropriate piece of equipment to satisfy the design criteria. Traditional 2D documentation has always shown these pieces of equipment as the bases for spatial requirements and system planning. The final equipment selection may be of a different type, however the performance data would have to be as near as possible to the design data for the consultant to approve its use. Performance data is the basis for the construction data and hence should be imbedded within the Design model.

In addition, many Building Services consultants like to separate the Equipment Schedules from the Drawing data. BIM is about a Single Point of truth for all data and therefore performance data should exist in the model and schedules extracted from the Model Equipment. Clauses in Consultancy agreements will still be protected based on the (OR APPROVED EQUAL CONCEPT) which exists in most Consultant Tender Documentation. Propagating metadata during the design phase allows the construction process to flourish and also enables the Sub-contractor to utilise the model for further model progression.

Clearance Zones and Associated Access Allowance

When planning any Building Services design, maintenance access, equipment removal and egress paths are allowed for to ensure that the plant rooms work. To ignore the clearances as part of the BIM process does not allow for accurate checking of the modelled information. 2D documentation has always identified

clearance zones around equipment as defined by the manufacturer. Tube withdrawal zones for maintenance of chillers. Pump / Fan maintenance access etc. If these clearances and accesses zones are not modelled during design, chances are the installed facility will have poor maintenance access to all equipment.

Ceiling Void Services Planning

Ceiling Void Coordinated section - Allocation of service zones as an initial requirement for any projects coordinated spatial requirement is essential as a datum in establishing major service runs and associated equipment locations. The main barrier to this concept is the requirement for BIM to reduce ceiling void space to maximize tenantable area and increase level numbers for high rise building construction in an effort to meet DA height constraints as prescribed within the design brief and in line with local regulatory requirements. However the allocation of these services zone can greatly reduce the effort required for clash detection in the development of the project.

Family Creation

It is important to realise that modelled content used for the purposes of BIM must be created and defined in a manner that not only meets the design requirements but also meets the downstream model usage at each phase of BIM deliverables. It must be stated that content created should and must be reviewed and quality checked to ensure that its intended purpose is met. It is suggested that all content created as part of any BIM project deliverable is supplied to the end client for handover to the facility owner for the purposes of future usage on subsequent facility modifications. This includes all system based component content and their associated table based data (i.e. Revit Lookup tables for Pipe Fittings). If spatial coordination is undertaken with the BIM process, assurances from all project stake holders must be supplied as to the accuracy of the content. Listed below, a few areas that also need to be considered when creating BIM specific families.

- For use in coordination as well as a design aid, it is useful to add a serviceable ‘zone’ within your families. This can indicate mandatory maintenance and access requirements that might otherwise get missed by other team members.
- When assigning connectors to the Families it is important to use the correct connector settings to allow the data to transmit through the system once inserted in the model.
- Revit doesn't display annotations in Families on non-perpendicular views such as lights or air terminals on sloped ceilings. In this instance, place model lines over the top of the symbolic lines in the Family and set them to a different sub-category so they can be manipulated with visual graphics settings once inserted into the model.
- When downloading families from external sources a review should be made of the parameters used so that filters and other data based searches are still effective within the project. This is of particular note for duct and pipe fittings and accessories.

Schedules

- Use Panel schedules for electrical boards and equipment. Like other schedules Panel schedules can be modified to suit a particular standard and used inside a specification or project brief to avoid rework.

Project Specific Data Requirements

The following section is an example from an actual project that indicates some of the data requirements for models used in BIM for FM rather than BIM for design or construction. In this example the project specifics had models created in Autodesk Revit and being published into Ecodomus in its role of Facility Data Integration Tool (FDIT).

Universal Data Requirements (Project Specific)

The below fields are a minimum only, additional project specific values maybe required to achieve prescribed model and data management outcomes. These properties are to be applied as Revit Shared Parameters.

- Level (Required to standardise the Level Identification in Revit)
- Phase (Construction Phase)
- Zone (Construction Zone)
- Sector (Modelling Sector)
- Package (Delivery Package)
- Building ID (For Multi- Building Sites, Facility ID)

Element / Asset Code and Description

At project start-up It is Important to establish a unified method of Asset identification for all Equipment. This data can then remain connected to the Asset up until practical completion and onto FM.

Minimum Revit Shared Parameter requirements

- **InstanceName –** Assigned to the Asset Number when data is pushed to the FDIT Database from Revit.
- **InstanceDescription –** Assigned to the Asset Description when data is pushed to the FDIT Database from Revit.
- **TypeName –** Assigned to FDIT Type Name when data is pushed to the FDIT Database from Revit.
- **TypeDescription –** Assigned to FDIT Type Description when data is pushed to the FDIT Database from Revit.

QSID (Quantities ID)

Is a Cost requirement utilised within the DWFX file format. Values are propagated as part of the overall Cost establishment process for use with CostX. Other cost estimating applications may utilize a different method and/or have varied property requirements.

Omniclass

Is an FDIT requirement and is utilised when assigning Asset Types. These Ominiclass values then align with the universal Cobie format for Facilities Management.

Integrate BIM into Facility Data Systems

The following section is an example from an actual project that indicates some of the modelling differences for models used in BIM for FM rather than BIM for design or construction. In this example the project specifics had models created in Autodesk Revit and being published into Ecodomus in its role of Facility Data Integration Tool (FDIT).

This section deals with the creation, development, setup, upload of models for use in facility data integration. Specifically this guide details the processes of taking models created within Autodesk Revit through to facility data integration.

While the output of models for use in a facility data integration tool is quite simple, it is important to consider the end user and the work processes that will be applied to the model to ensure that the end result is intuitive and user friendly.

The basic process (desktop and web viewer);

1. Clean rooms and spaces in Revit models
2. Generate facility data virtual floors
3. Output Revit models to NWC files
4. Output floor plans to DWG files
5. Combine NWC files in Navisworks for a federated model
6. Combine floor plans into federated model
7. Color code federated model
8. Create viewpoints for each room (both internal and above ceiling)
9. Publish NWD file of federated model
10. Upload NWD file to facility data integration tool BIM server
11. Use the BIM connector tool in Revit to upload model data
    a. The federated NWD model must be uploaded prior to the data upload.

The basic process (mobile application viewer)

1. Clean rooms and spaces in Revit models
2. Generate facility data virtual floors
3. Output Revit models to NWC files
4. Output floor plans to DWG files
5. Combine NWC files in Navisworks for a federated model(s)
6. Combine floor plans into federated model(s)
7. Color code federated model(s)
8. Create viewpoints for each room (both internal and above ceiling)
9. Publish DWF file of federated model
10. Extract viewpoints from DWF file
11. Using Hoops viewer save DWF file as HSF file
12. Upload HSF file to BIM server ensuring to select the NWD file as the master model
13. Open the HSF file within the BIM server
14. Import viewpoints extracted from DWF file

Editing and cleaning the authoring models

The level of effort in the development of an FM system can be significantly affected by the cleanliness and accuracy of the data with the BIM environment. There are differences in how data needs to be treated for an FM environment than what is needed for a design or construction environment, for this reason some additions and modifications may be required within the authoring models to achieve an effective FM result.

Model items requiring review and editing

Several types of model components and component types that require review to be of direct use within the FM environment which either differ from the usages in design and construction or are specific to the requirements of facility data integration.

Rooms – Revit room objects

Room objects are included within an Autodesk Revit architectural model and are used to associate the various building components to their physical location within a project. Revit room objects relate to the FM component Space, this should not be confused with the Space component within Autodesk Revit and so for clarity FM spaces will be indicated for the remainder of this document as space(FM) while Revit spaces will simply be referred to as space.

FM requirements of a space(FM)

Within the FM environment a space(FM) is defined from the floor level to the soffit of the above slab or underside of the room, whichever the case may be and therefore ignores the ceiling as a boundary of the space(FM). This is to associate above ceiling building assets to the space(FM) in which you would need to be in order to access that asset.

The area of a space(FM) can vary from an FM perspective and the project contract should be referred to in order to clarify the requirements, however from a COBie perspective spaces(FM) are defined in the Architectural programming phase of a project and are therefore measured to the centreline of walls with no gaps between them.

This means that in order to automatically associate above ceiling components to spaces(FM) the room object in the Revit model may need to be adjusted to extend to the underside of the above slab or roof. This may require the removal of ceiling components as room bounding objects.

Facility data requirements of a space(FM)

To achieve the use of space(FM) elements within the facility data integration there are certain room requirements in Revit that must be maintained:

- Room must be fully bound
- Room must have a Room Tag assigned to it
- Room must be named

Editing rooms in Revit – Names and Numbers

Ensuring that rooms are named and numbered is most easy to achieve through the use of schedules within Revit.

For best results and easiest work processes include at least the following parameters in the Room Schedule;

- Level
- Number
- Name
- Area

This will allow the sorting of rooms by these parameters, typically first sorted by level then by number. Area allows the identification of rooms that have not been places within the model.

With the room schedule available ensure that all rooms are named and numbered according to the project requirements.

Rooms final thoughts

The requirements of rooms as they apply to FM don't differ very much from the requirements of rooms as they apply to Architectural models. For this reason the requirements of the rooms may be introduced to the contract and deliverable requirements of the Architect (with appropriate quality checking and control systems) without fundamentally changing the Architect's deliverable and contract conditions.

Spaces (Revit MEP space objects)

Revit includes objects called spaces, these are very similar to rooms but include within them calculations for heating and cooling loads and other (MEPF) functions. This makes these spaces very different from spaces(FM) within FM systems. However the use of spaces within Revit (MEP) also allows for the automated identification of MEFP components with their location, additionally it allows the definition of zones which are fundamentally the same between their usage for FM and their usage within Revit.

Decisions affecting spaces

As noted the usage of spaces within Revit is quite different to the usage of spaces(FM) in an FM environment. Revit spaces are used for MEFP energy calculations which requires their layout to be different to the layout requirements of spaces(FM) in an FM environment. However these requirements for Revit spaces only affect the design period of the development of the building information model, whereas the model being used in FM is the fabrication model that does not include these requirements.

In this situation a decision needs to be made as to whether the spaces in the Revit model should be modelled to the FM requirements or modelled to the Revit requirements.

The basis of this decision finally means the difference between changing spaces in Revit to extent from floor to underside of the above slab/roof, or to associate the above ceiling assets to the to the spaces(FM) manually.

Editing spaces in Revit - Names and numbers

The name and number of the spaces within the Revit MEP models must match the names and numbers of the rooms in the Revit Architecture model. This will ensure that the components are assigned to the correct spaces(FM) in the facility data integration tool.

Tools exist within the Autodesk subscription toolset that allow the automated matching of room names and numbers from linked architectural models to the space names and numbers of the Revit MEP models. This tools is called the space re-naming utility.

Zones

Zones are used within FM systems to associate spaces(FM) together based on various conditions and usages. Revit also contains zones to combine spaces in fundamentally the same way. Because of this alignment the facility data integration tool reads the zones in the Revit MEP models and applies this data.

To ensure correct output the zones should be named and numbered correctly according to the project standards.

For effective results in the development of the FM model for facility data integration the minimum fields that should be included in the HVAC Zone schedule are;

- Level: allows for the sorting and/or filtering of the schedule into smaller sections that can be more easily edited and completed.
- Name: is the critical characteristic that is being dealt with.
- Gross Area: allows the quick identification of zones that have no spaces assigned.

Editing zones in Revit - Assigning spaces to zones

Zones associate spaces together based on various requirements and data relationships. Where zones are used and modelled all spaces should be assigned to a zone.

Within Revit when a space is not assigned to a zone it is automatically assigned to a placeholder zone called default. The assignment of the zone “default” indicates that a space is not assigned to a zone.

There are 2 simple methods for the identification of spaces to zones;

- Using the heating and cooling loads window
- Using schedules

Spaces not assigned to zones can be identified within the schedules by including the field; zone, in the schedule. Unassigned spaces will have the zone parameter show a value of Default.

To best identify spaces within the model that are unassigned the schedule will need to include the minimum set of fields as follows;

- Level
- Number
- Name
- Area
- Zone

Zones Final Thoughts

Spaces can only be added to a single zone within a model. However there are many different types of zones within the FM systems and facility data integration tools. For this reason zones may be required within each of the Revit MEP discipline models.

Where a space is required to be within 2 different zones within a single discipline model assign the space to the zone that represents the major zones for that discipline, further associations will need to be made within the facility database.

Model items requiring additions

While some model components require additional work in order for them to be efficient in the development of the facility data integration FM model, some model components will require additional work to reduce the effort in this development.

Asset and type identification

Facilities management revolves heavily around the management of assets in various ways. The management of these assets is performed primarily through data base systems and these database systems require that each asset to have a unique identification number within the project.

Each asset also belongs to a specific type, such as the type of model of light fixture (here model refers to the manufacturers product number) or the type of chair. As with the assets each type of asset in the project requires a unique identification number.

These identification numbers associate the attributes (data) and documents to each asset and asset type within the project and are generally used for so many purposes that they are quite critical to have them correct.

Several thousand identifiers may be associated with a project so a clear standard for the generation of the identifiers needs to be a part of each project.

In the default configuration of most facility data integration tools the system derives these identifiers first for asset types by combining Revit family name and Revit type name. Asset identifiers are the derived by adding a numerical suffix to the type identifier. This can be problematic as this derived data will rarely match the standards for the project.

To overcome this facility data integration tools can derive this data from specific incorporated parameters so that the information passed to the FM system through BIM is clear, concise and accurate.

As asset identifiers can often incorporate the type identifiers the below process will first deal with editing the type identifiers followed by the asset identifiers.

The type parameters to add will be;

- TypeName
- TypeDescription

The asset parameters to add will be;

- InstanceName
- InstanceDescription

Editing asset type parameters - exporting type parameters

There are many types of assets within any model for a building project that must be correctly named, and a simple and easy method of accessing the name data of the types is through the use of schedules. Within Revit there will be many schedules for this as each schedule will deal with a single category of components.

As a minimum these schedules should include the following standard data fields;

- Family (Family Name in BIMLink)
- Type (Type Name in BIMLink)
- Type Mark
- Omniclass Number
- Description
- TypeName
- TypeDescription

Family (Family Name): used to identify the Revit family to which the component belongs

Type (Type Name): used to identify the Revit type of the component

Type Mark: often used to identify particular asset types for the project and may be the source of the information that is used for the naming within the facility data integration tool.

Omniclass Number: useful for checking compliance where project delivery standards require the application Omniclass classifications.

Description: typically this is slightly more useful for the identification of asset types than the family name or type name

TypeName: the added parameter that will be used for the asset type name in the facility data integration tool (becomes the name of the type from a COBie perspective)

TypeDescription: a description parameter used by facility data integration tools.

So as to improve the efficiency of the editing/application of the asset type names to the TypeName parameter of the Revit components it is recommended to use BIMLink to export these parameters to Microsoft Excel for editing, and then using BIMLink import the edited data back to Revit.

Editing asset type parameters - editing type parameters

Editing these parameters;

- TypeName
- TypeDescription

As has been noted sets the Asset type name and description that will be used within the FM system. The applied name must adhere to the naming specification from the facility management team, and in some projects these names may be supplied directly from that team.

Editing the parameters may be edited within either Revit, by filling out the parameter data for each type or may be edited within Microsoft Excel where the schedule has been exported via BIMLink as noted in the previous section.

The advantage of using BIMLink is that it is far more efficient to edit large datasets within Microsoft Excel than it is using Revit.

Here all required types must have their asset type name added as a minimum value.

Not all data exported via BIMLink is editable, or at least the results will not be changed when the data is imported. BIMLink identifies the parameters/parameter values by colouring the cells grey in the Microsoft Excel sheet.

NOTE: DO NOT CHANGE any of the data under the field ID. This data associates the information in exported sheet to the model components. Changing this data will result in BIMLink being unable to write the parameter information back to the model components.

Regardless of the method used to edit the parameter values, ensure that all asset types have their TypeName parameter filled before proceeding to the next step.

Editing asset parameters - exporting the asset parameters

There are many types of assets within any model for a building project that must be correctly named, and a simple and easy method of accessing the name data of the types is through the use of schedules. Within Revit there will be many schedules for this as each schedule will deal with a single category of components.

As a minimum these schedules should include the following standard data fields;

- Family (Family Name in BIMLink)
- TypeName
- TypeDescription
- Level
- Room(Space) Number
- Room(Space) Name
- Mark
- InstanceName
- InstanceDescription

Family (Family Name): used to identify the Revit family to which the component belongs

TypeName: the added parameter that will be used for the asset type name in the facility data integration tool (becomes the name of the type from a COBie perspective)

TypeDescription: a description parameter used by the facility data integration tool.

Level: used to sort the individual assets by level to assist in working through and completing the data editing

Room(Space) Number: The number of the room object (or space object for Revit MEP) within which the asset is located used to sort the schedule to ease of data editing

Room(Space) Name: The name of the room object (or space object for Revit MEP) within which the asset is located used to sort the schedule to ease of data editing

Mark: a unique identifier hard coded to Revit. This automatically checks for duplications, but is not robust enough for FM purposes as assets require unique names across the entire project not just against their same classification (category).

InstanceName: Added parameter used to store the asset name that will be applied within the facility data integration tool.

InstanceDescription: a description parameter used by the facility data integration tool

So as to improve the efficiency of the editing/application of the asset names to the InstanceName parameter of the Revit components it is recommended to use BIMLink to export these parameters to Microsoft Excel for editing, and then using BIMLink import the edited data back to Revit.

Editing asset parameters - editing the parameters

Editing these parameters;

- InstanceName
- InstanceDescription

As has been noted sets the Asset name and description that will be used within the FM system. The applied name must adhere to the naming specification from the facility management team, and in some projects these names may be supplied directly from that team.

Editing the parameters may be edited within either Revit, by filling out the parameter data for each model component or may be edited within Microsoft Excel where the schedule has been exported via BIMLink as noted in the previous section.

The advantage of using BIMLink is that it is far more efficient to edit large datasets within Microsoft Excel than it is using Revit.

Here all required components must have their asset name added as a minimum value.

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NOTE: DO NOT CHANGE any of the data under the field ID. This data associates the information in exported sheet to the model components. Changing this data will result in BIMLink being unable to write the parameter information back to the model components.

Regardless of the method used to edit the parameter values, ensure that all asset types have their InstanceName parameter filled before proceeding to the next step.

Parameters final thoughts

The control of the naming of Revit families and types in neither easy nor practical, because of this it would be advisable to roll out these identifiers to the model authoring teams (either design or detailers).

If these parameters are not edited within the Revit model the time expenditure for fixing the naming within the project can extend to days or weeks of effort in editing each and every asset and type, one at a time.

Where no naming system is supplied simple asset and asset type naming formatting can be as follows;

Asset type:

Facility ID – Type Mark

Asset

Asset Type Name – Space(FM) Number (incorporating the level) – Sequential instance number.

Not every type and instance of component in every model is a tracked asset in FM systems. Because of this it is advisable to add a parameter to the model types and instances to indicate that those components are tracked assets. This allows for the data export and editing to be filtered so that only appropriate elements are worked on, while also allowing the filtering of the models that are exported and uploaded to the BIM server to only include tracked assets.

When exporting the data model asset types all types are exported, regardless of whether they are in use within the model or not. For this reason productivity can be improved through purging the models prior to exporting the data for editing, thereby ensuring that only asset types actually within the model are exported.

Conclusion

BIM is very common now for design and even in some regions for construction. For asset management however BIM is still quite new and although there have been some high profile projects completed to FM systems this is still not the normal delivery.

Taking BIM to FM is not onerous if some simple steps are followed which include:

- Planning the requirements
- Mapping the workflows
- Building technology plans
- Communications continually with all parties
- Adherence to modelling standards
- Quality procedures over the project

I will show some demonstrations through the presentation on successful BIM to FM and can provide further literature for interested parties via email.

Thank you for your attendance and please ask questions as these sessions are to aid in the growth and adoption of new techniques that with lift the industry to the next level in delivery.